

The Development of Remote Sensing Performance Standards



A joint effort of FEMA, NASA,
NOAA and Topographical
Engineering Center

Partnerships - Integral to the Process



- The following illustration involves four Agencies of the U.S. Government
 - Army Corps of Engineers Topographical Engineering Center
 - National Air and Space Administration
 - Federal Emergency Management Agency
 - National Oceanic and Atmospheric Administration's River Forecast Centers

FEMA Flood Evaluations

- **Future Use of Remote Sensing, Models and GIS in floods by FEMA**

✉ *IFSAR*

✉ *LIDAR*

✉ *Data Fusion*

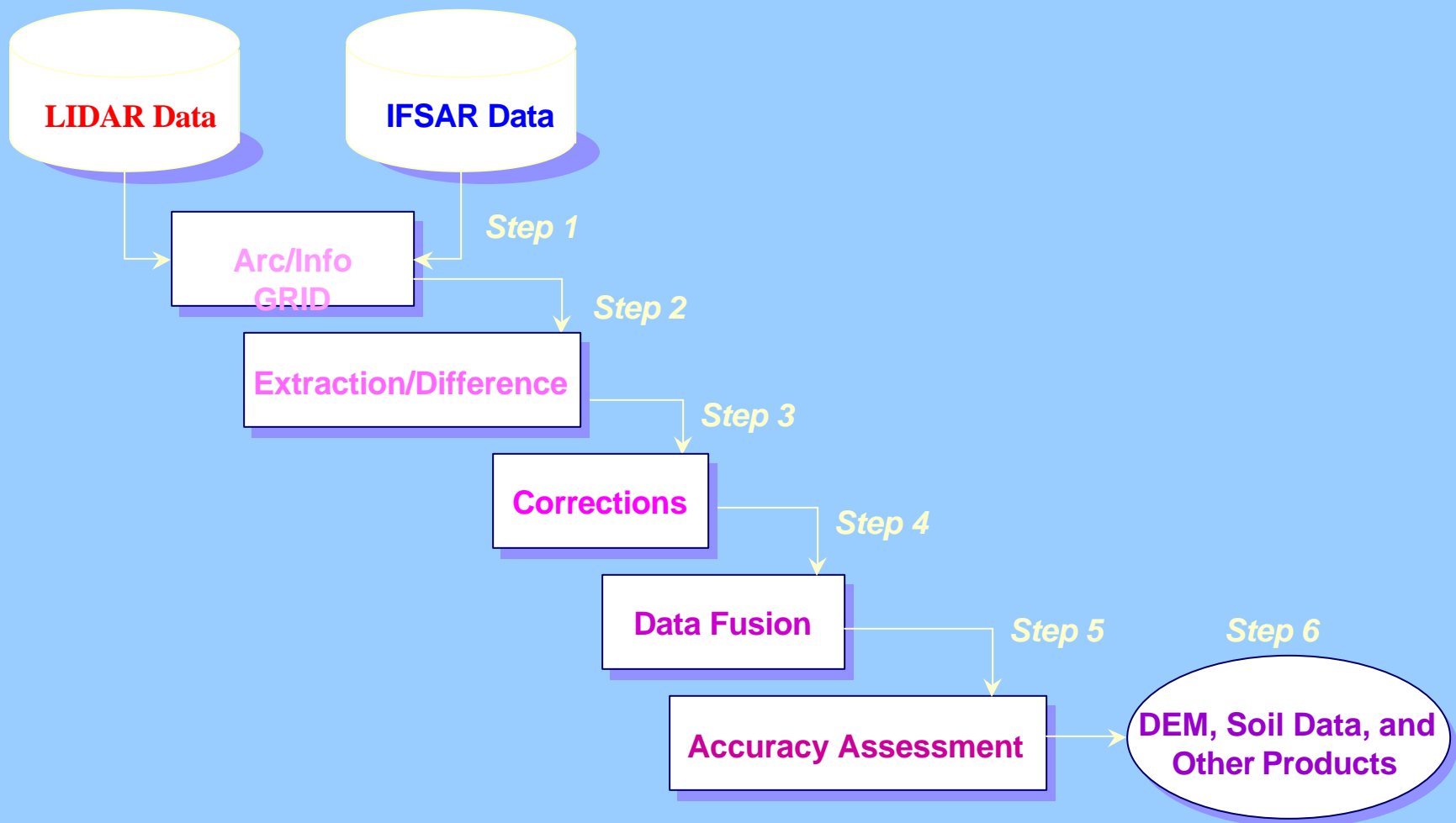
✉ *Dynamic Flood Modeling*

LIDAR Data Collection can be used to Add Accuracy

- IFSAR is Absolute Accuracy of 1 to 1.5 Meters
- But Differential Accuracy is about 15 Centimeters
- LIDAR Absolute Accuracy is about 15 Centimeters
- Data Fusion should yield Overall Absolute Accuracy of about 15 Centimeters at Lower Cost than Current Technology

Complementing Use of Remote Sensing for Flood Mapping

Proposed IFSAR and LIDAR Fusion



AUTOMATED MAPPING USING IFSAR



MAGNITUDE



CORRELATION



ELEVATION

DATA CHANNELS

MAGNITUDE

CORRELATION

VOLUME DÉCOR

RMS MAGNITUDE

ELEVATION GRAD

CORR GRADIENT

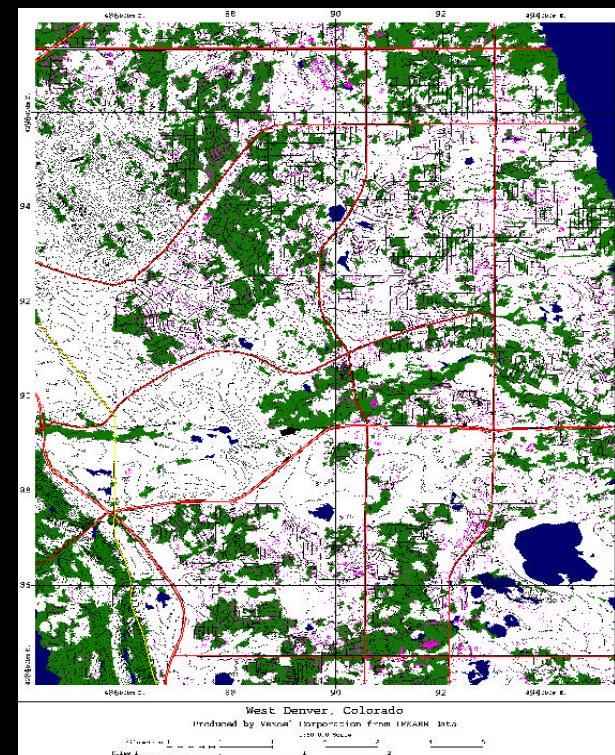
SHADED RELIEF

CLASSIFICATION

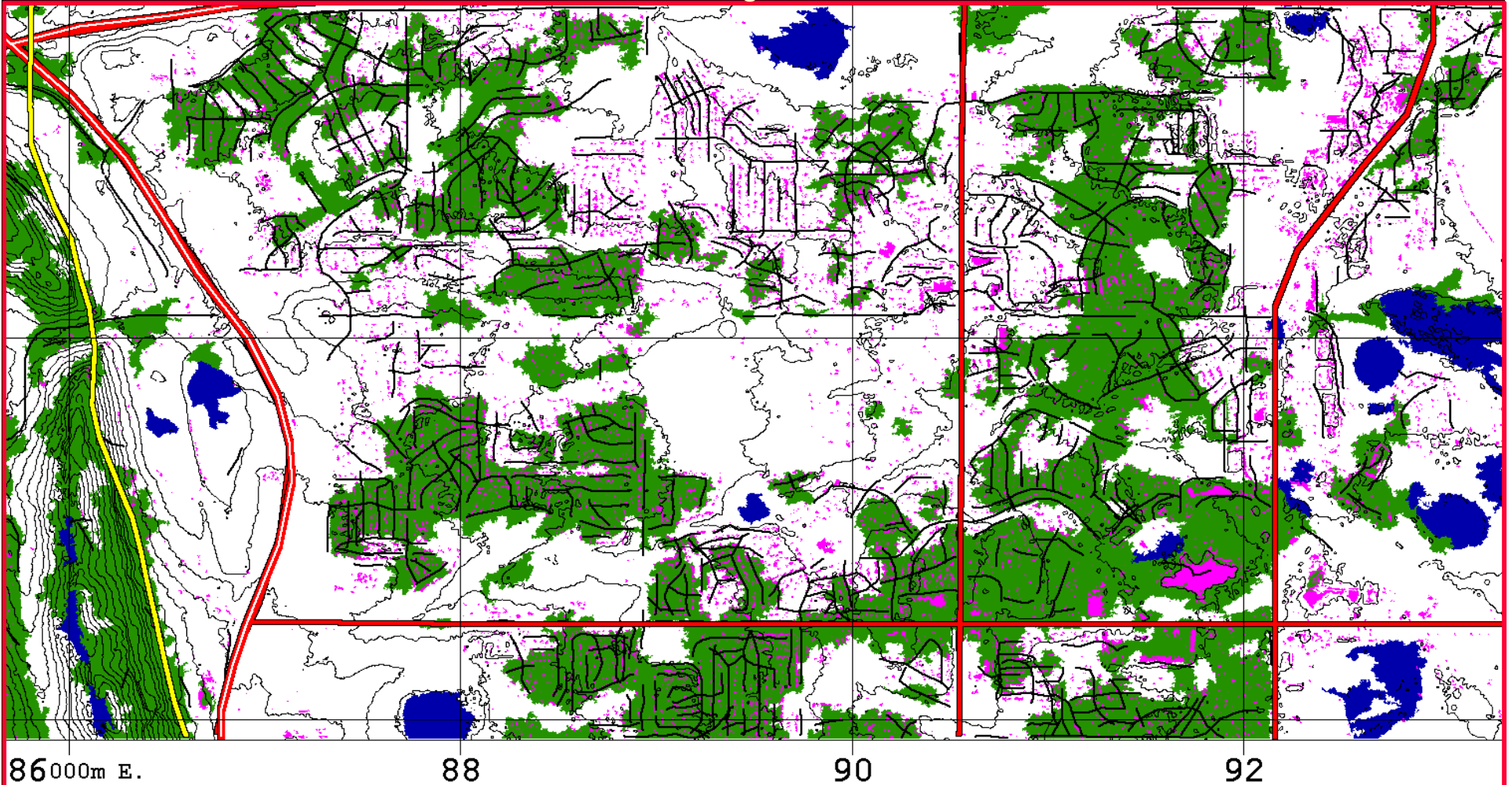
ELEVATION

BALD EARTH

TERRAIN ANALYSIS
FEATURE EXTRACT
ROAD EXTRACTION
MAP COMPOSITION
EXPORT



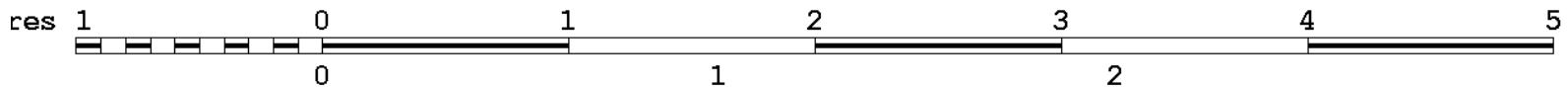
Map of 7 1/2' Area, West Denver, Colorado Fragment



West Denver, Colorado

Produced by Vexcel Corporation from IFSARE Data

1:60 000 Scale

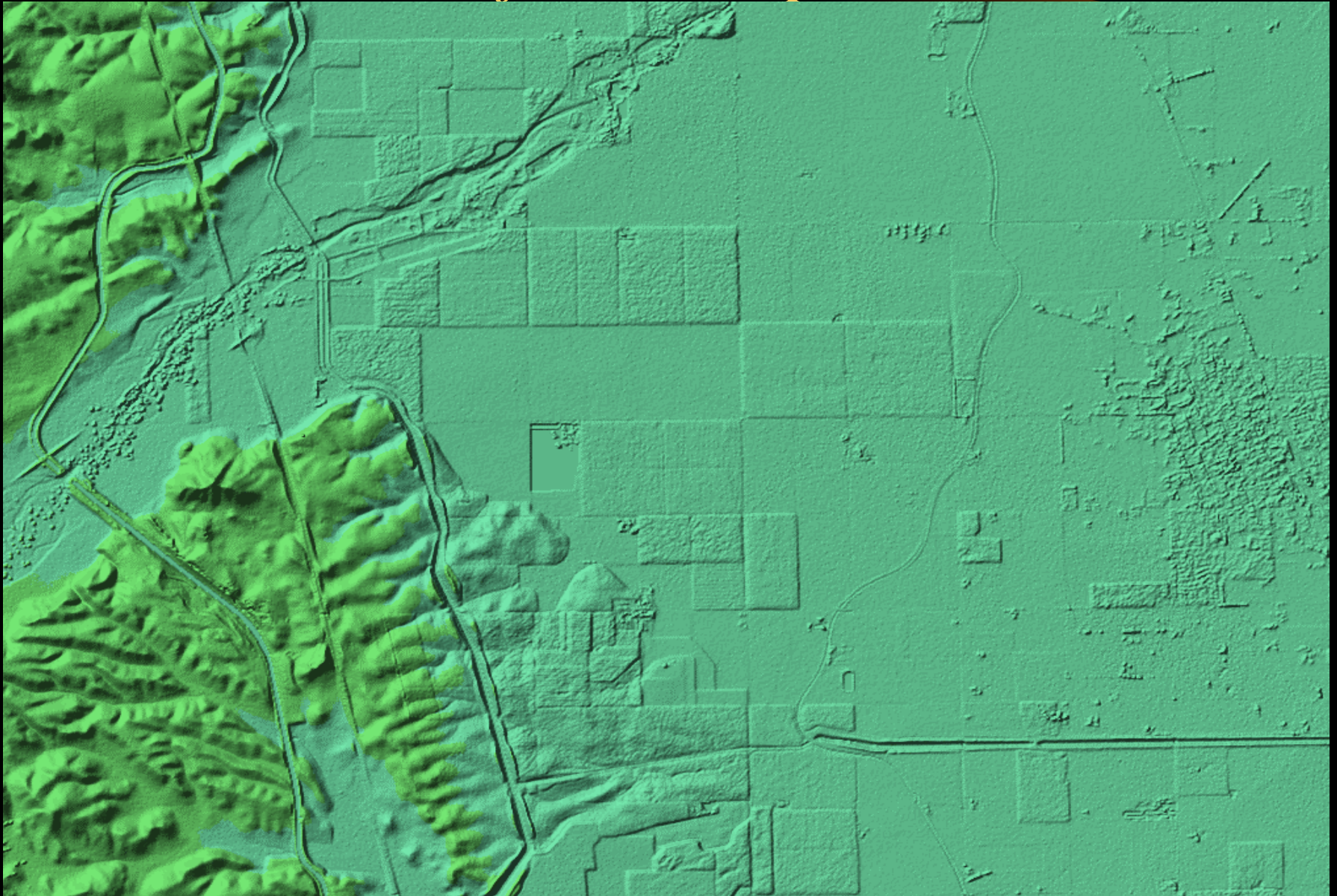


The California Condition 1997 - 1998 Test Areas



San Joaquin Valley IFSAR DEM

California Aqueduct



San Joaquin Valley IFSAR DEM

Stockton, California




San Joaquin Valley IFSAR DEM

Stream with Riparian Vegetation



Lidar Study Background

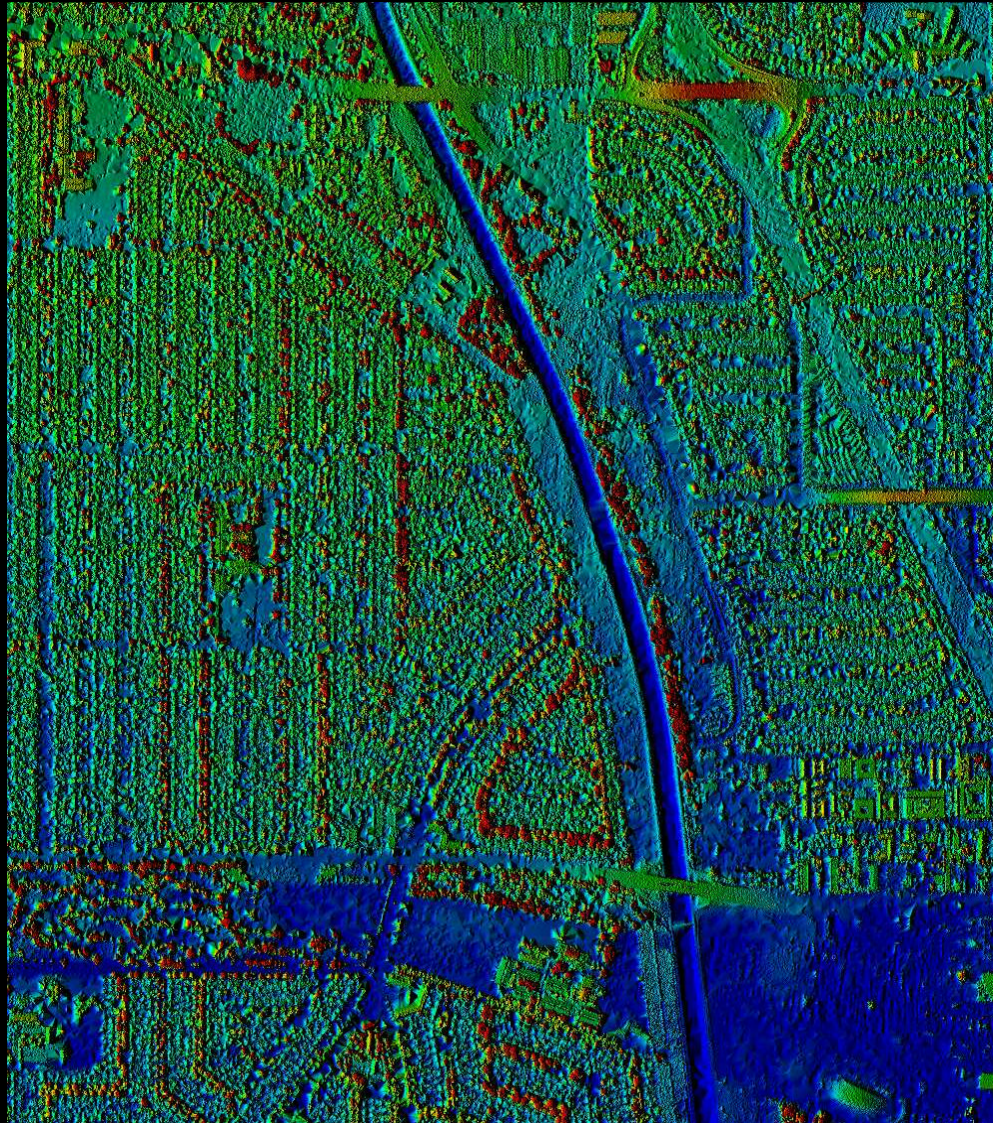
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- Lidar topographic mapping has emerged as a significant new technology
 - FEMA sponsored commercial collections of Lakewood, CA test site with four providers
 - USATEC contracted JHU/APL to analyze the data & provide recommendations
 - Will use data to guide data fusion

Joint Agency's Objectives & Approach

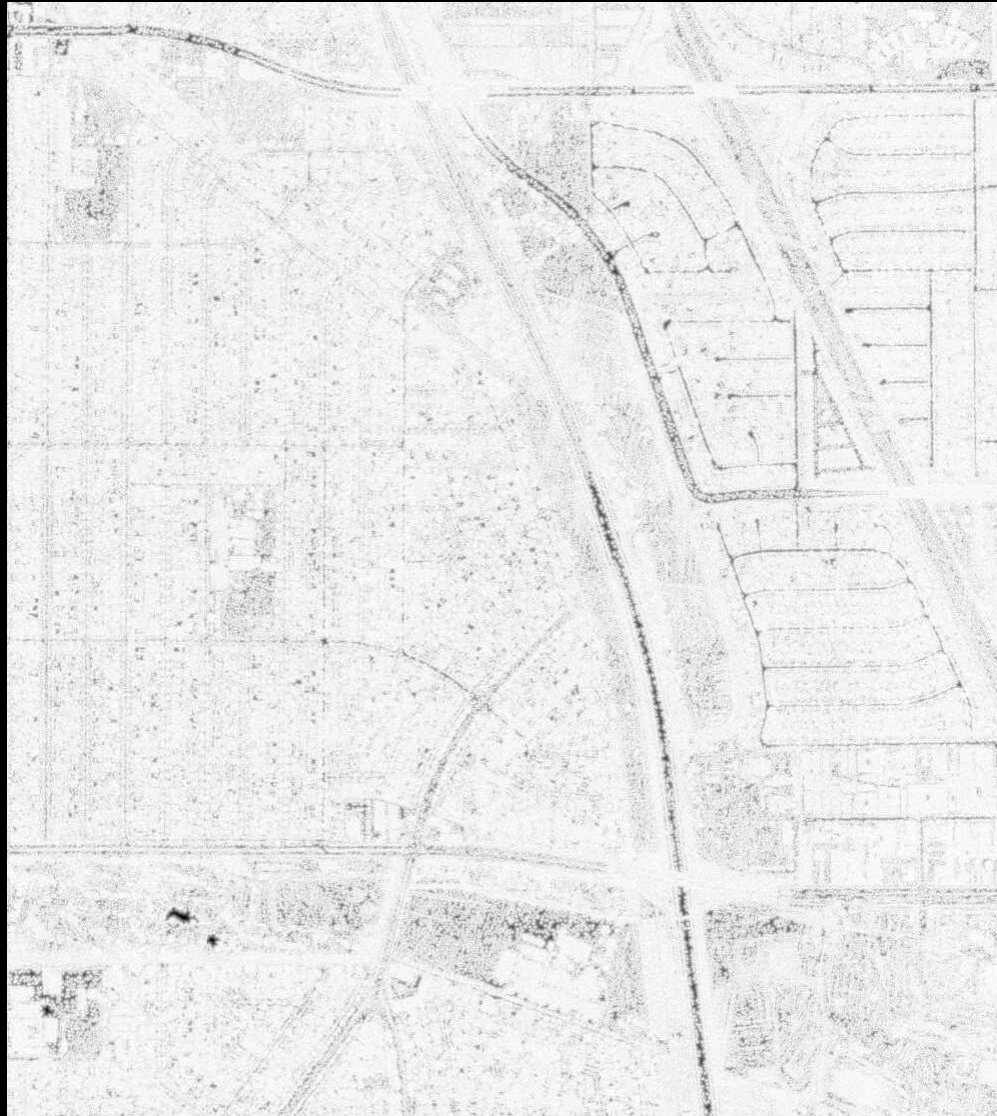


- Objectives
 - Provide data-analysis-derived recommendations for FEMA 37 specifications
 - Provide information to drive data fusion investigation
- Approach
 - Data display
 - Accuracy assessment
 - Comparative analysis
 - Translation of findings into specifications

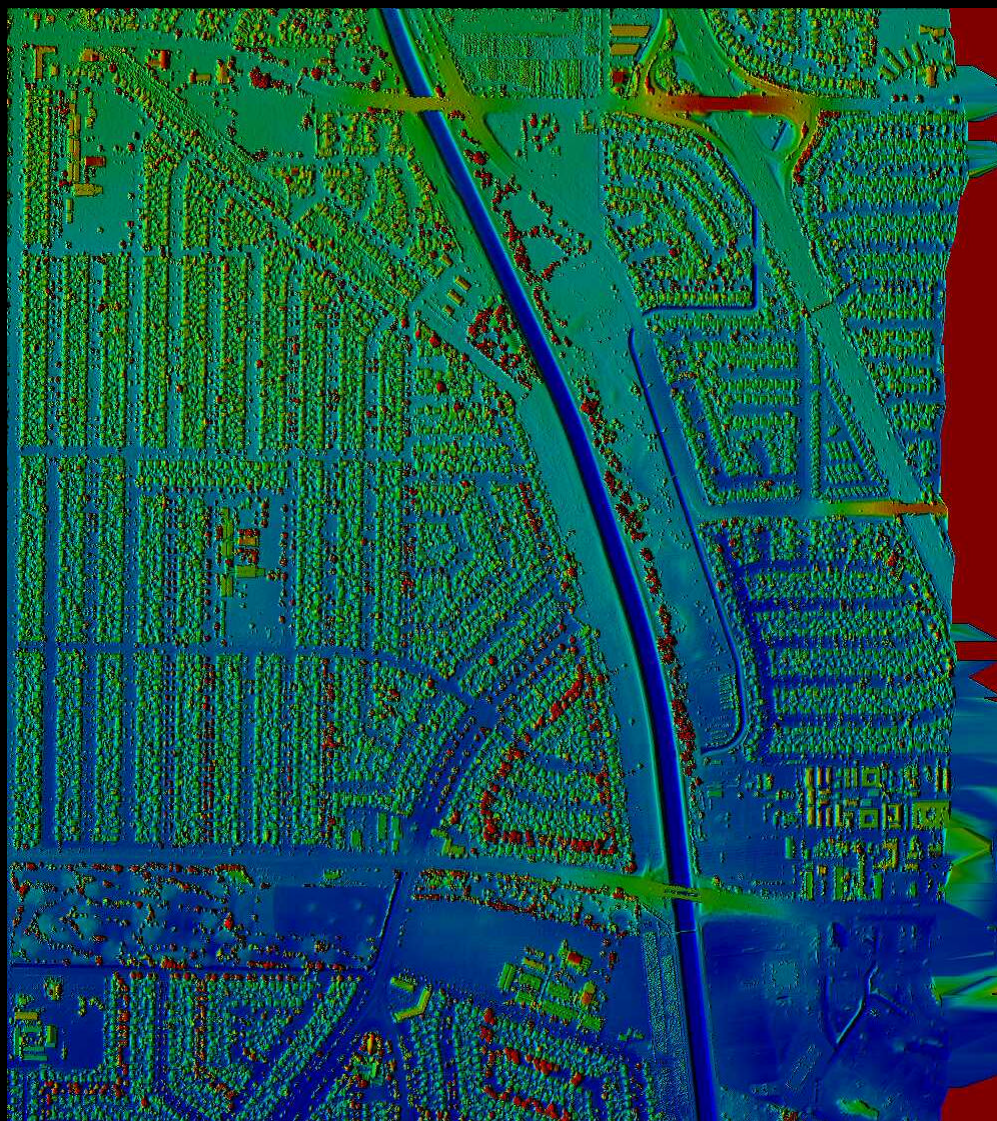
Least Accurate Data



Void Map of Least Accurate Data



Most Accurate Data



Void Map of Most Accurate Data

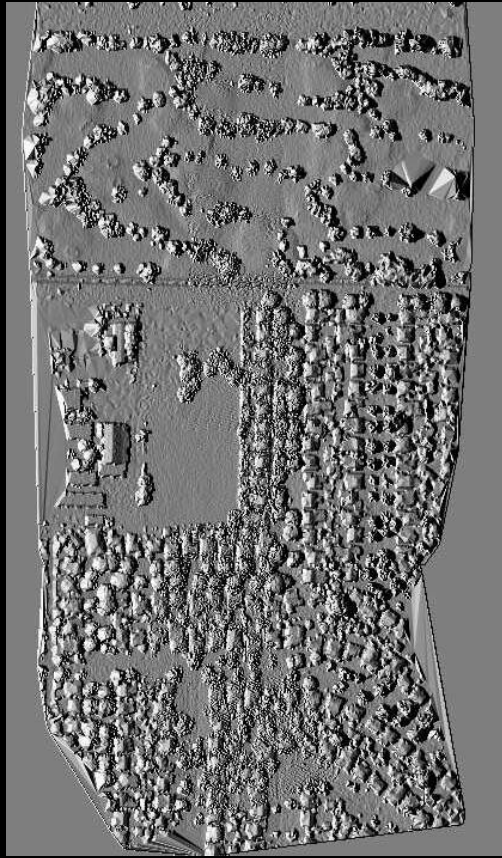


Merge Artifacts

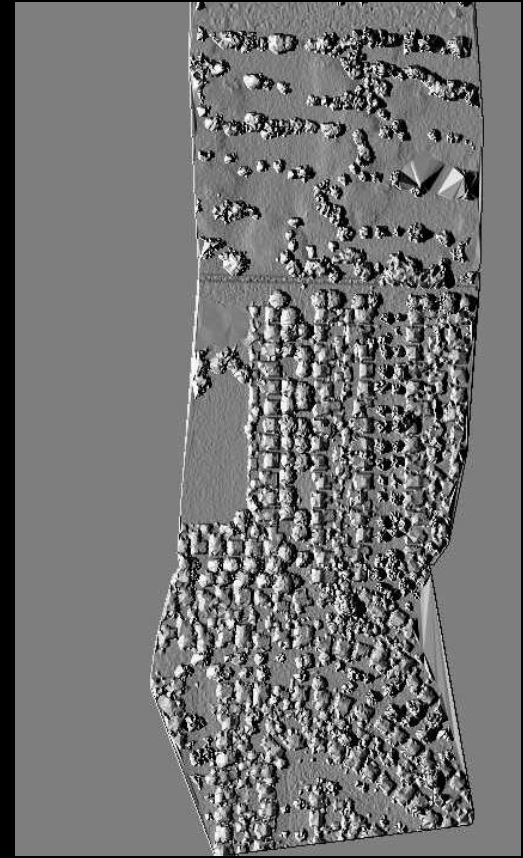
Swath 1



Merged Swaths

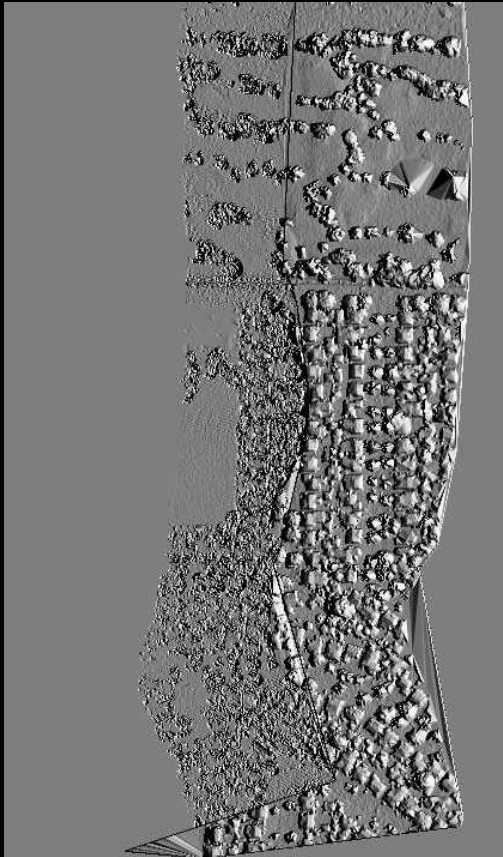


Swath 2

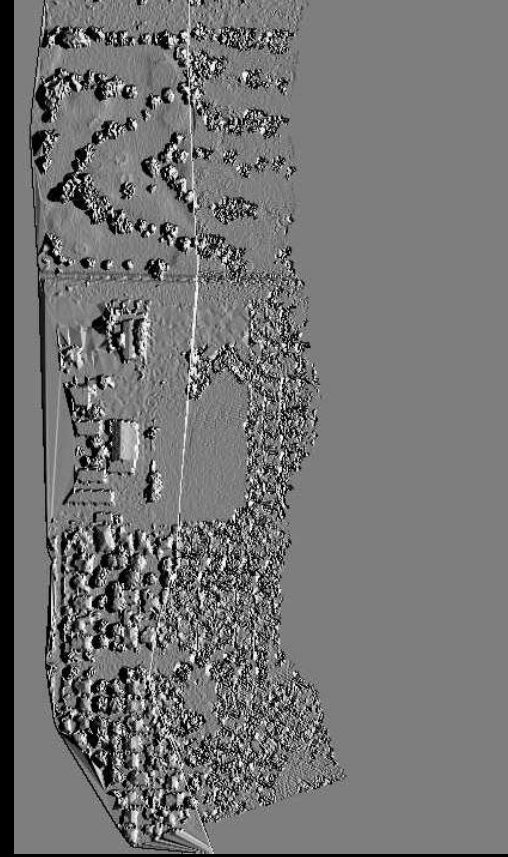


DEM Differencing Example

Merged Swaths - Swath 1



Merged Swaths - Swath 2



Study Plans



- Complete accuracy assessment
- Complete comparative analysis
- Translate findings into additional working specifications

Conclusions for Draft Lidar Performance Standard



- Color-coded-sun-shaded display reveals artifacts
- Void display reveals additional details
- Quantitative measure development underway
- Expect recommendations to ensure quality of LIDAR performance standards

FEMA's New Working LIDAR Standard



- Has developed a performance standard
- Available for use
- Viewable at

www.fema.gov/mit/tsd/MM_lidar.htm

Dynamic Flood Modeling

- NOAA's River Forecast Centers and the Army Corps of Engineers Hydrologic Engineering Center are Implementing Dynamic Flood Models
- These can Forecast both Inundation and Flash Flood Boundaries
- Will Permit Improved Flood Insurance Rate Maps
- Will Reduce Unneeded and Unheeded Flood Warnings